Devine Tarbell & Associates, Inc.
Consulting Engineers, Scientists, & Regulatory Specialists

Principals:
John J. Devine, P.E., President
John C. Tarbell, P.E.
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January 25, 2005

005.0003.0100/2.0

Mr. Gil Paquette, CWB, PWS
TRC Environmental Corporation
400 Southborough Drive
South Portland, ME 04106

Subject: **Preliminary Geotechnical Investigation Report**
Northeast Reliability Interconnect
Proposed Orrington Substation Expansion
Orrington, Maine

Dear Mr. Paquette:

Devine Tarbell & Associates, Inc. (DTA) is pleased to provide TRC Environmental Corporation (TRC) with this draft letter report summarizing the results of a preliminary geotechnical engineering investigation for the subject project. The purpose of this investigation was to explore and summarize the site subsurface conditions at the proposed substation expansion. Included in this report are the results of subsurface explorations and laboratory testing. The field investigation summarized in this letter was performed concurrent with a Class C-Medium High Intensity soil survey performed by Mr. Paul Corey in support of the project license application process. At this time, design of the substation expansion is in its early stages, and as such, structure loads, settlement tolerances, and performance standards have not been established. Accordingly, this letter report is considered a preliminary investigation of the site; a final geotechnical investigation should be performed at a later date as design progresses.

A summary of the project understandings, investigation, laboratory testing program, and subsurface conditions is presented in the following subsections.

1.0 Project Understandings and Description

Bangor Hydro Electric Company proposes to expand an existing substation in Orrington, Maine (Figure 1). The expansion is part of the Northeast Reliability Interconnect Project. DTA has

970 Baxter Boulevard · Portland, Maine 04103

Portland, Maine
207-775-4495/1031 (fax)

Charlotte, North Carolina
704-377-4182/4185 (fax)

Sacramento, California
916-564-4214/4203 (fax)

Bothell, Washington
425-485-5668/5934 (fax)

Syracuse, New York
315-641-1624/1626 (fax)

Bellingham, Washington
360-671-1150/1152 (fax)

been contracted to provide geotechnical engineering services in support of permitting and design of the expansion. Proposed structure loads and performance standards are unknown at this time. Accordingly, recommendations regarding suitable foundation system(s) (i.e., shallow or deep foundations), allowable bearing pressures, settlement estimates, and site preparation details are not provided in this report. It is anticipated that these recommendations and details will be developed at a later date as design progresses.

Base on our understanding of the project, the following structures are anticipated as part of the expansion:

- Two 345 kV breakers
- Four gang operated 345 kV switches
- One control house
- One dead end truss
- Miscellaneous instrument transformers and carrier traps
- Miscellaneous conduit, ground grid, and other underground facilities
- Three series capacitor platforms
- Three single pole breakers
- Three sets of disconnect and bypass switches for the series capacitors
- Three single pole dead end structures
- 12 to 16 bus supports (to provide electrical connections between the dead end poles and the series capacitors switches)

The site is located on the north side of Fields Pond Road. The proposed expansion is approximately 200 feet by 250 feet in plan dimension, and will occur on the south side of the existing substation (between the substation and Fields Pond Road). The ground surface topography is generally flat and slopes gradually downward from west to east from approximately elevation 150 feet to 130 feet (Figure 2). The south side of the substation is generally grass-covered, with occasional clusters of tree and low brush growth. Two gravel-surfaced roads provide access to the existing substation from Fields Pond Road near the proposed expansion, one located along the west border of the expansion site, and the other through the center of the expansion site. A 5-foot-deep storm water detention basin exists on the east side of the expansion area, and a localized 3-foot to 5-foot-deep ditch diverts surface drainage from the eastern-most access road toward the detention basin. Localized 2-foot-deep ditches also flank each side of the access roads.

2.0 Subsurface Investigation

2.1 2004 Investigation

Subsurface explorations performed in support of this investigation were conducted by Hughes Bros. of Hampden, Maine on December 29, 2004 using a track-mounted excavator. The field investigation consisted of excavating four test pits (TP-1-04 through TP-4-04) at the locations shown on Figures 1 and 2. The test pits were excavated at locations, and to depths, where impacts upon the future development should be minimized. The test pit locations were located in the field by DTA and Paul Corey by taping from existing landmarks. The test pits were excavated to depths of between 5.5 feet and 13 feet below ground surface (bgs). Representative soil samples were collected for characterization and subsequent laboratory testing. Field torrvane shear testing and pocket penetrometer testing were occasionally performed at various depths in fine-grained soils to estimate undrained shear strength (S_u) and unconfined compressive strength (q_p), respectively. The penetrometer measurements also provide an estimation of undrained shear strength. During excavation, water seepage levels were observed and measured and recorded on each test pit log.

The explorations were monitored on a full-time basis by a DTA geotechnical engineer who visually characterized the recovered samples and encountered strata, and prepared written field logs of the subsurface conditions encountered. Logs of the test pits, prepared by DTA, are presented in Attachment A.

2.2 1989 Investigation.

Previous geotechnical investigations were performed between 1989 and 1990 in support of permitting and design of a previous 345 kV transmission line arrangement. As part of this previous geotechnical investigation program, a series of borings were drilled along the proposed 345 kV transmission line alignment. One boring, B-85-3, was drilled on the north side of the existing substation at the approximate location shown on Figures 1 and 2. This boring was drilled by DTA (Northrop, Devine & Tarbell, Inc. at that time). This boring was drilled to a depth of 31.5 feet using standard wash boring techniques. The log of that exploration is provided in Attachment B for reference.

3.0 Laboratory Testing

Laboratory testing for the 2004 investigation consists of index testing of the encountered soils. The testing consisted of one grain size distribution analysis (ASTM D422), one Atterberg limit determination (ASTM D4318), and six natural moisture content determinations (ASTM D2216). The results of those tests are presented in Attachment C and on the logs in Attachment A.

4.0 Subsurface Conditions

The surficial geology at the site from the ground surface downward generally consists of localized fill, glacio-marine (marine) deposits (silty fine sand to silty clay with increased depth), and glacial till. The thickness of the marine soils and upper surface of the till are variable. The marine deposit was found in each test pit, and thickness was less near the northwest corner of the expansion site. The marine soils were not fully penetrated in three of the test pits (TP-1-04 through TP-3-04), and the glacial till was not encountered in these three explorations. A brief description of the encountered soil strata is presented in the following subsections.

4.1 Fill

Fill was encountered at one test pit (TP-4-04) at ground surface and immediately above the marine clay. The fill consisted of well-graded gravelly fine to coarse sand with trace silt, and was 1 foot thick. The fill appeared to be dense to very dense based on visual observation and excavation resistance.

4.2 Glacio-Marine Deposits

Marine deposits were encountered at the ground surface or below the fill, and consisted of two distinct substrata with increased depth as follows: an upper silty sand and sandy silt, grading to an underlying silty clay. The marine deposit substrata are interpreted to be part of the Presumpscot Formation that was deposited in a glacio-marine environment between 12,000 and 15,000 years ago as the glacial ice retreated near the last Wisconsin glaciation. The marine soils were found to be present at each test pit location. A summary of each substratum is presented in the following subsections.

4.2.1 Glacio-Marine Silt and Sand

Marine silt and sand was encountered at the ground surface in TP-1-04 through TP-3-04. This substratum consisted of brown to olive-brown silt and silty fine sand, with lesser amounts of clay. This substratum contained occasional silty clay and clayey silt layers and lenses. The silt and sand was generally non-plastic to slightly-plastic, and was up to 8 feet in thickness, where encountered. The silt and sand was underlain by marine silty clay (although it was not fully penetrated in TP-3-04), and was generally interpreted to be a component of the "upper crust" of the Presumpscot Formation. The silt and sand was estimated to be medium dense based on excavation resistance and visual observation.

4.2.2 Glacio-Marine Silty Clay

Marine silty clay was encountered in each test pit below fill or the upper marine silt and sand except at TP-3-04; it is likely that this excavation was terminated before this soil was encountered. This substratum contained occasional silt and fine sand layers of varying thicknesses. The silty clay was typically brown near the upper contact with the marine silt and sand, becoming olive-gray to gray with increasing depth. The upper 3 to 4 feet of the silty clay was generally found to be a stiff upper crust that is typical of the Presumpscot Formation (continuation of the marine silt and sand crust discussed in the previous subsection).

The silty clay was encountered at depths between about 1.5 and 8 feet bgs, and is of undetermined thickness except at TP-4-04 (2 feet thick). The undrained shear strength (S_u) was estimated by torrvane and pocket penetrometer measurements. The results of this testing is shown on the test pit logs in Attachment A. Given the depth of test pits TP-1-04 and TP-2-04, this testing was occasionally performed on recovered samples that were brought to the surface by the excavator bucket, and as such, the samples inherently experienced some disturbance (as noted on the logs in Attachment A). The undrained shear strength generally ranged between about 800 and 3,000 pounds per square foot (psf), which indicate it is firm to very stiff, and decreased in strength with increased depth. Estimation of the stiffness of the clay based on visual observation was generally consistent with the torrvane and pocket penetrometer measurements.

An Atterberg limit determination was performed on one representative sample, which yielded a liquid limit and plastic limit of 33.7 and 20.9 percent, respectively. Natural moisture contents of the silty clay ranged from approximately 22 to 30 percent. The Atterberg limit test and natural moisture content results on the tested samples indicate that the soil is within the plastic range, and indicates it is over-consolidated and not sensitive to disturbance.

4.3 Glacial Till

Glacial till was encountered at one test pit (TP-4-04), and was encountered below the marine clay. The till consisted of an unsorted mixture of silt, sand, and gravel, with lesser amounts of clay and cobbles. The till was encountered at a depth of 3.5 feet bgs, and was of undetermined thickness. The till appeared to be dense to very dense based on visual observation and excavation resistance. A grain size distribution analysis performed on a representative sample of the till indicates that the tested sample was poorly graded, with approximately 45 percent by weight finer than the standard No. 200 sieve opening. The natural moisture content of the tested sample was 12.6 percent.

4.4 Groundwater

Groundwater observations and measurements were made during excavation of the test pits. The ground water level observations ranged from approximately 4 to 6 feet bgs, and were found to generally mirror the ground surface. Ground water was not encountered in TP-4-04, except that perched seepage was observed at 1.5 feet at the top of the marine clay. Water levels are subject to fluctuation due to season precipitation patterns, temperature, spring snow melt, and construction conditions, and therefore may vary from those encountered during this investigation.

5.0 Summary of Findings

The results of this preliminary investigation show that the site is underlain by up to approximately 12 feet of a combination of medium dense to very dense and stiff overburden soils. Marine silty clay was encountered at three explorations, and this material was not fully penetrated near the central and southern portions of the site. This soil is expected to become softer with increased depth. Because the thickness, strength, and compressibility characteristics of this marine clay have not been fully established, it should be characterized in greater detail as design proceeds. In addition, the loading and structure performance standards are unknown at this time. However, based on our understanding of the type of equipment to be installed, and our understanding of the subsurface conditions at this time, it does not appear that geological conditions will inhibit or prohibit the development of this facility. It is recommended that a more detailed geotechnical investigation be conducted to establish foundation support requirements when final design of the facility approaches, and when a better understanding of the structure loads and performance standards have been established.

It has been a pleasure providing TRC with geotechnical engineering services for this project. If you should have any questions regarding this preliminary report, or if we can be of further assistance, please call.

Sincerely,

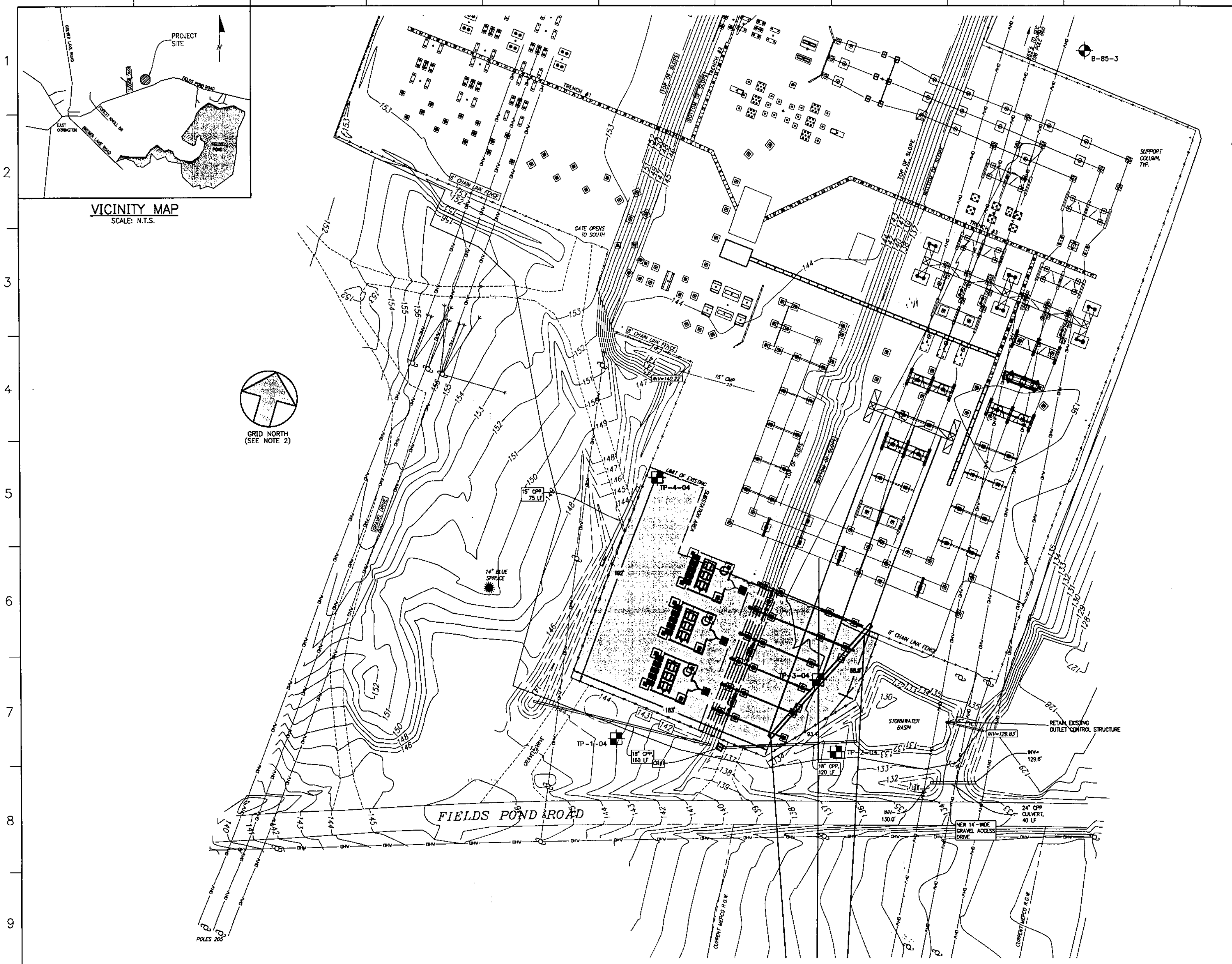
DEVINE TARBELL & ASSOCIATES, INC.

Lyle N. Tracy, P.E.
Senior Geotechnical Engineer

STATE OF MAINE
LYLE N. TRACY #6830
REGISTERED PROFESSIONAL ENGINEER

LNT/jkr
Attachments

cc: File
B. Stetson



NOTES:

1. BASED ON SGC ENGINEERING, LLC. DRAWING NO. 187005_0S_TOPO.DWG ENTITLED "LIMITED EXISTING CONDITIONS SURVEY, ORRINGTON, SUBSTATION, FIELDS POND ROAD, TOWN OF ORRINGTON, PENOBSCOT COUNTY, STATE OF MAINE, DATED 11/22/04.
2. NORTH AS SHOWN REFERS TO GRID NORTH AND IS BASED ON THE MAINE STATE COORDINATE SYSTEMS, EAST ZONE.
3. VERTICAL INFORMATION AS SHOWN IS REFERENCED TO NAVD 88.
4. TOPOGRAPHIC AND PLANIMETRIC INFORMATION AS SHOWN IS THE RESULT OF AN ON-THE-GROUND FIELD SURVEY PERFORMED BY SGC ENGINEERING, LLC BETWEEN NOVEMBER 15, 2004 AND NOVEMBER 17, 2004.
5. THE LOCATIONS OF FOOTINGS AND STRUCTURES WITHIN THE FENCED SUBSTATION AREA HAVE BEEN COMPILED BASED ON DESIGN INFORMATION PROVIDED BY BANGOR HYDROELECTRIC COMPANY.
6. WETLANDS AS SHOWN HAVE BEEN DELINEATED BY DEVINE TARBELL & ASSOCIATES.

LEGEND:

EXISTING — PROPOSED

SWALE CENTERLINE
EDGE OF GRAVEL
EDGE OF PAVEMENT
ROAD CENTERLINE
GRADE CONTOUR
CULVERT
OVERHEAD WIRES
PROPOSED EXPANSION

CORRUGATED PLASTIC PIPE — CPP
CORRUGATED METAL PIPE — CMP
INVERT — INV.
UTILITY POLE
CONIFEROUS TREE
EDGE OF WOODS/BRUSH
WETLANDS
1989 TEST BORING (LOCATION APPROXIMATE)
2004 TEST PIT

TOWN OF ORRINGTON MAINE

PROPOSED SITE PLAN
FIELDS POND ROAD

BANGOR HYDRO ELECTRIC COMPANY
BANGOR, MAINE

Devine Tarbell & Associates, Inc.
Consulting Engineers, Scientists, & Regulatory Specialists
970 Baxter Blvd., Portland, Maine 04103

ISSUE		LE	PE	DATE
0	PRELIMINARY GEOTECHNICAL REPORT	–	LT	25 JAN 2005

SCALE: 1" = 40'	PROJ. NO. 005.0003.0100		REV
	DWG. NO. FIGURE 1		0
DESIGNED –	DRAWN SGC/MLN	LEAD ENGR. –	
DESN. CHK'D. –	DWG. CHK'D. L.TRACY	PROJ. ENGR. L.TRACY	

NOTES:

1. BASED ON SGC ENGINEERING, LLC. DRAWING NO. 187005_OS_TOPO.DWG ENTITLED "LIMITED EXISTING CONDITIONS SURVEY, ORRINGTON, SUBSTATION, FIELDS POND ROAD, TOWN OF ORRINGTON, PENOBSCOT COUNTY, STATE OF MAINE, DATED 11/22/04.
2. NORTH AS SHOWN REFERS TO GRID NORTH AND IS BASED ON THE MAINE STATE COORDINATE SYSTEMS, EAST ZONE.
3. VERTICAL INFORMATION AS SHOWN IS REFERENCED TO NAVD 88.
4. TOPOGRAPHIC AND PLANIMETRIC INFORMATION AS SHOWN IS THE RESULT OF AN ON-THE-GROUND FIELD SURVEY PERFORMED BY SGC ENGINEERING, LLC BETWEEN NOVEMBER 15, 2004 AND NOVEMBER 17, 2004.
5. THE LOCATIONS OF FOOTINGS AND STRUCTURES WITHIN THE FENCED SUBSTATION AREA HAVE BEEN COMPILED BASED ON DESIGN INFORMATION PROVIDED BY BANGOR HYDROELECTRIC COMPANY.
6. WETLANDS AS SHOWN HAVE BEEN DELINEATED BY DEVINE TARBELL & ASSOCIATES.

LEGEND:

	SWALE CENTERLINE
	EDGE OF GRAVEL
	EDGE OF PAVEMENT
	ROAD CENTERLINE
85	GRADE CONTOUR
SD	CULVERT
OHW	OVERHEAD WIRES
CORRUGATED PLASTIC PIPE	CPP
CORRUGATED METAL PIPE	CMP
INVERT	INV.
	UTILITY POLE
	CONIFEROUS TREE
	EDGE OF WOODS/BRUSH
	WETLANDS
B-85-3	1989 TEST BORING (LOCATION APPROXIMATE)
TP-2-04	2004 TEST PIT

TOWN OF ORRINGTON MAINE

EXISTING CONDITIONS PLAN
FIELDS POND ROAD

BANGOR HYDRO ELECTRIC COMPANY
BANGOR, MAINE

DTA Devine Tarbell & Associates, Inc.
Consulting Engineers, Scientists, & Regulatory Specialists
970 Baxter Blvd., Portland, Maine 04103

ISSUE		PCT	ARCH	CIVIL	ELEC	GEOT	HVAC	INSTR	PIPING	STRUCT	LE	PE	DATE
0	PRELIMINARY GEOTECHNICAL REPORT					LT					-	LT	25 JAN 2005

SCALE: 1"=40'	PROJ. NO. 005.0003.0100	DWG. NO. FIGURE 2	REV 0
DESIGNED –	DRAWN SGC/MLN	LEAD ENGR. –	
DESN. CHK'D. –	DWG. CHK'D. L.TRACY	PROJ. ENGR. L.TRACY	

ATTACHMENTS

ATTACHMENT A
2004 TEST PIT LOGS

TEST PIT LOG

Date	Project	Test Pit No.	Project No.
12/29/04	NRI	TP-1-04	005.0003.0100

Ground Elevation 143	Location Orrington Substation	Sheet No. 1 of 1
Depth to Groundwater 4'	Surface Conditions Grassed	

DEPTH (FEET)	SAMPLE NO.	LAB TEST	WATER CONTENT (%)	SOIL CLASS.	DESCRIPTION	ELEVATION (FEET)	REMARKS
0–1				SM	TOPSOIL 0.5-1.0' Brown silty fine sand with organics. moist.	142'±	
1–8	S1 @ 2.5'		23.7	SM-ML	MARINE SILT & SAND Brown silty fine sand with silt and fine sandy silt layers; moist; mottled to 4'; medium dense. @ 6' little clay with silty clay seams.		seepage @ 4'!
8–12.5	S2 @ 8'		24.1	CL	8' MARINE SILTY CLAY Olive-brown silty clay with trace fine sand, moist, stiff.	135'	
12	S3 @ 12'		28.7		12.5'	131.5'	@ 12': TV=1.1-1.3 KSF PP=2.6, 3.0, 3.4 KSF
13–15					BOE @ 12.5' Notes: 1. TV = torrvane (Su) 2. PP = pocket penetrometer (qp)		partially disturbed

08005D

DTA

TEST PIT LOG

Date	Project	Test Pit No.	Project No.
12/29/04	NR1	TP-2-04	005.0003.0100

Ground Elevation	Location	Sheet No.
134'	Orrington Substation	1 of 1

Depth to Groundwater	Surface Conditions
4.5'	grassed with localize tree growth

DEPTH (FEET)	SAMPLE NO.	LAB TEST	WATER CONTENT (%)	SOIL CLASS.	DESCRIPTION	ELEVATION (FEET)	REMARKS
1				SM	TOPSOIL 0.5'-1' Brown silty fine sand with organics; moist	133'±	
2–3				SM-ML	MARINE SILT & SAND Brown silty fine sand with fine sandy silt layers & silty clay lenses. mottled; moist; med. dense.		
4–6					@ 4' Gray-brown sandy silt, little clay with clayey silt lenses; mottled; moist; med. dense.		seepage @ 4.5'
7	S1 @ 7'		23.4		7'	127'	
8–10				CL	MARINE SILTY CLAY Alternating layers of brown silty clay & clayey silt, with fine sandy silt lenses, mottled; moist; stiff; blocky/Fractured. @ 9' few to no sandy silt lenses.		
11	S2 @ 11'		30.5		@ 11' Gray-similar.		
12–13	S3 @ 13'	A	30.9		@ 13 Firm to stiff. LL = 33.7%; PL = 20.9% 13'	121'	@ 13': TV = .84, .86, 1.06 ksf PP = 1.0, 1.0, 1.4 ksf
14–15					BOE @ 13'.		partially disturbed

Notes:
1. TV = torrvane (Su)
2. PP = pocket penetrometer (qp)
3. LL = liquid limit.
4 PL = plastic limit.

08005D

DTA

TEST PIT LOG

Date 12/29/04	Project NRI	Test Pit No. TP-3-04	Project No. 005.0003.0100
Ground Elevation 136'	Location Orrington Substation	Sheet No. 1 of 1	
Depth to Groundwater 5.5'	Surface Conditions grassed.		

DEPTH (FEET)	SAMPLE NO.	LAB TEST	WATER CONTENT (%)	SOIL CLASS.	DESCRIPTION	ELEVATION (FEET)	REMARKS
1				SM	TOPSOIL 0.5-1.0 — Brown silty fine sand with organics; moist	135±	
2				SM-ML	MARINE SILT & SAND — Brown & Rust-brown fine sand, little to some silt; moist; mottled; med. dense		
3							
4					@ 3.5' Gray & brown silty fine sand, fine sandy silt, & clayey silt (alternating); moist to wet;		
5					5.5 — med. dense - stiff	130.5'	seepage @ 5.5'
6					BOE @ 5.5'		
7							
8							
9							
10							
11							
12							
13							
14							
15							

108005D

DTA

TEST PIT LOG

Date	Project	Test Pit No.	Project No.
12/29/04	NRI	TP-4-04	005.0003.0100

Ground Elevation	Location	Sheet No.
143	Orrington substation	1 of 1

Depth to Groundwater	Surface Conditions
None	grassed.

DEPTH (FEET)	SAMPLE NO.	LAB TEST	WATER CONTENT (%)	SOIL CLASS.	DESCRIPTION	ELEVATION (FEET)	REMARKS
0–0.5				SM	TOPSOIL 0.5' — Brown silty fine sand with organics; moist.	142.5'	
0.5–1.5				SW	FILL 1.5' — Brown gravelly fine to coarse sand, trace silt; moist; med. dense - dense.	141'	perched seepage @ 1'.
1.5–3.5	S1 @ 2.5'		22.5	CL	MARINE SILTY CLAY 3.5' — Brown silty clay; moist, stiff; mottled.	139.5'	@ 2.5': TV = 1.5, 1.6, 1.7 KSF; PP = 5.5, 6.8, 7.0 KSF
3.5–6.0	S2 @ 5.5'	G	12.6	SM	GLACIAL TILL 6.0' — Brown silty fine to coarse sand, with gravel & cobbles; moist; dense to very dense.	137'	

BOE @ 6.0'

Notes:
1. TV = torrvane (S_u)
2. pocket penetrometer (q_p)

08005D

DTA

ATTACHMENT B
1989 BORING LOG

DEPTH (feet)	CASING BLOWS /FOOT	SAMP NO.	SAMP TYPE	LAB TEST	%W	Su (psf)	SOIL DESCRIPTION	SOIL CLASS	STANDARD PENETRATION RESISTANCE (blows/foot) 0 10 20 30 40 50 60	PIEZ DATA	ELEV. (feet)
0	Hollo	S-1					TOPSOIL 0.5'	OL-ML			0
	Stem						MARINE SILTY CLAY		7	•	
	Auger	S-2					Brown silty clay, stiff.	CL-ML			
	I				21.6				18		
	I										
5	I	C-1			24.2			CL-ML			-5
	V				25.4	QU2420	Lab Vane: 640-1180 psf				
	6					FV4000		CL-ML			
	16	S-3				FV4000					
	22				29.0		10'		13		
10	17	C-2			31.9		Medium consistency.				-10
	22				34.7	QU1190	Lab Vane: 480-560 psf				
	24					FV2010	LL=34.2 PL=20.2	CL-ML			
	25					FV1610	13.5'				
	25	S-4					GLACIAL TILL Brown gravelly silty sand with sm	SM-ML			
15	50						cobbles, very dense.				-15
	68								91		
	50										
	47										
	86										
20	130	S-5						SM-ML			-20
	190										
	wash								67		
	ahead										
	I										
25	I	S-6						SM-ML			-25
	I										
	I								170		
	I										
	V										
30		S-7					31.5'	SM-ML	47		-30

BOTTOM OF EXPLORATION

* Water level assumed at ground s

For Drilled Pier Design:

STIFF SILTY CLAY (0.0-10.0')

Total Unit Weight.........118 pcf
Elastic Modulus...........1.0 ksi
Phi Angle.................0 degrees
Cohesion..................2400 psf
Alpha.....................0.3***
At-Rest Earth Pressure....1.5**

MEDIUM CLAY (10.0-13.5')

Total Unit Weight.........115 pcf
Elastic Modulus...........0.5 ksi
Phi Angle.................0 degrees
Cohesion..................1200 psf
Alpha.....................0.5***
At-Rest Earth Pressure....0.7**

GLACIAL TILL (13.5-31.5')

See Table 7

** Values can be increased by multiplying by 1.2 if drilling is accomplished using casing which is removed concurrent with concrete placement.
*** Increase by multiplying by 1.2 if drilling mud is not used. For clays, if the sustained loading accounts for more than 50% of the maximum uplift loading condition, multiply alpha by 0.67.

70 U: 3" thin wall tube S: split spoon R: rock C: 2" thin wall tube -70

2ND 345 kV TRANSMISSION LINE
BAILEYVILLE TO ORRINGTON, MAINE
BANGOR HYDRO-ELECTRIC CO.

NORTHROP, DEVINE & TARBELL, INC.
Engineering
Log of: BORING B-85-3
Project No.: 88-229-06
Date Drilled: 7/9/89

ATTACHMENT C
LABORATORY RESULTS

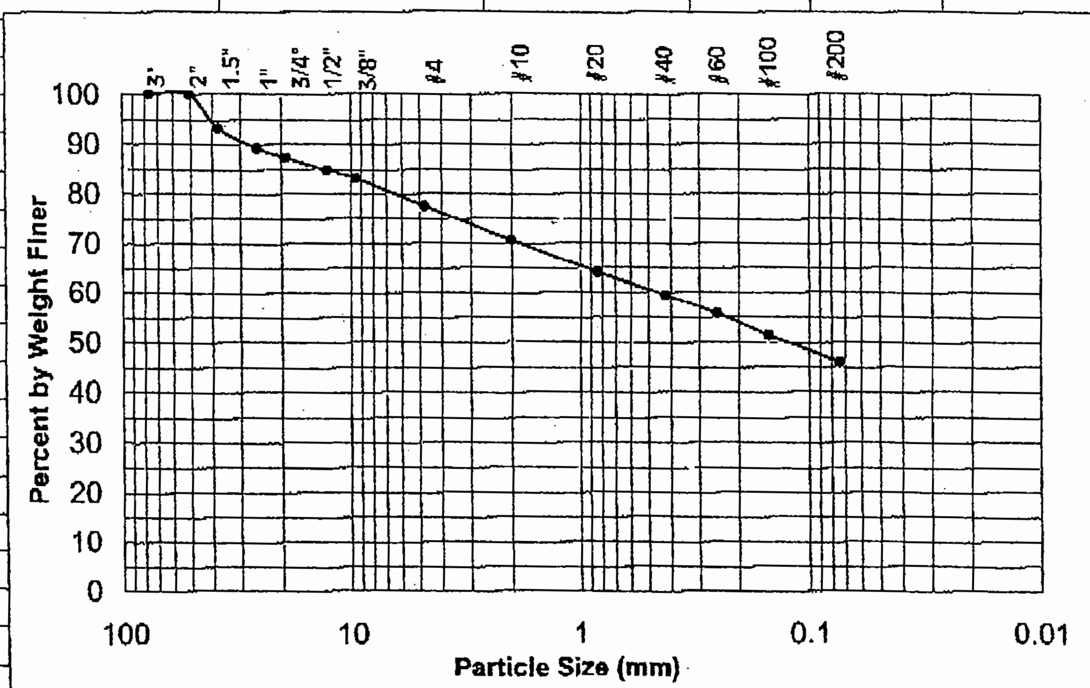
DEVINE TARBELL ASSOCIATES
BHE 345kV TIE-IN
WATER CONTENT

EXPLORATION	DEPTH (ft.)	CAN No.	WT. WET SOIL & CAN (g)	WT. DRY SOIL & CAN (g)	WT. H20 (g)	WT. CAN (g)	DRY SOIL (g)	WATER CONTENT (%)
TP-1-04 S1	2.5	A-11	478	428.5	49.5	219.2	209.3	23.7
TP-1-04 S2	8	7	265.62	224.14	41.48	51.92	172.22	24.1
TP-1-04 S3	12	8	260.92	214.41	46.51	52.21	162.2	28.7
TP-2-04 S1	7	9	248.18	210.93	37.25	51.74	159.19	23.4
TP-2-04 S2	11	10	325.44	261.47	63.97	52.05	209.42	30.5
TP-2-04 S3	13	X-3	74.27	61.89	12.38	21.88	40.01	30.9
TP-4-04 S1	2.5	11	290.38	246.61	43.77	51.9	194.71	22.5
TP-4-04 S2	5.5	A-50	962.9	880.6	82.3	226.5	654.1	12.6

SEVEE & MAHER ENGINEERS
4 BLANCHARD ROAD
CUMBERLAND CTR., MAINE 04021
(207) 829-5016

GRAIN SIZE ANALYSIS - ASTM D422

PROJECT NAME:	DTA			PROJECT No:	97008
	BHE 345 KV Tie-In Line			DATE:	11-Jan-05
SAMPLE DESCRIP:	Brown gravelly sandy SILT			BORING No:	TP-4-04
				SAMPLE No:	S2
				DEPTH (ft):	5.5
		DATA			
			SPECIFICATION		
U.S Std SIEVE (in.)	PARTICLE SIZE (mm)	% by WT. FINER	Min	Max	P / F
3	76.2	100.0			
2	50.8	100.0			
1.5	37.5	93.1			
1	25.4	89.2			
3/4	19.1	87.2			
1/2	12.7	84.7			
3/8	9.5	83.0			
#4	4.76	77.4			
#10	2.0	70.5			
#20	0.84	64.0			
#40	0.42	59.3			
#60	0.25	55.7			
#100	0.149	51.4			
#200	0.074	45.9			



Water Content (%) = 12.6

ATTERBERG LIMIT DATA SHEET

PROJECT: Devine Tarbell Assoc.

JOB NO: 97008
DATE: 10JAN05
TESTED BY: BJL

BORING No: TP-2-04
SAMPLE No: S3
DEPTH (ft.): 13

SAMPLE SOURCE:
SAMPLE DESCRIPTION: olive silty clay

SAMPLE PRETREATMENT:
(X) NONE
( ) AIR DRIED
( ) OVEN DRIED @ 60 C

SPLIT ON:
( ) No. 40 SIEVE
( ) No. 10 SIEVE
(X) NOT SPLIT

OVEN TEMP. FOR WATER CONTENTS:
( ) 60 C
(X) 110 C

PLASTIC LIMIT

				NAT. WATER CONTENT
CONTAINER No:	x-1	x-2		x-3
WT. WET SOIL + CONT.	35.33	37.98		74.27
WT. DRY SOIL + CONT.	32.92	35.20		61.89
WT. CONTAINER (g)	21.45	21.76		21.88
WATER CONTENT (%)	21.0	20.7		30.9

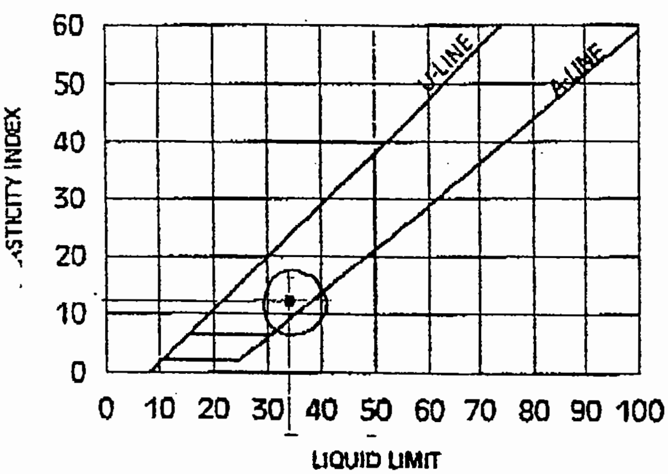
LIQUID LIMIT

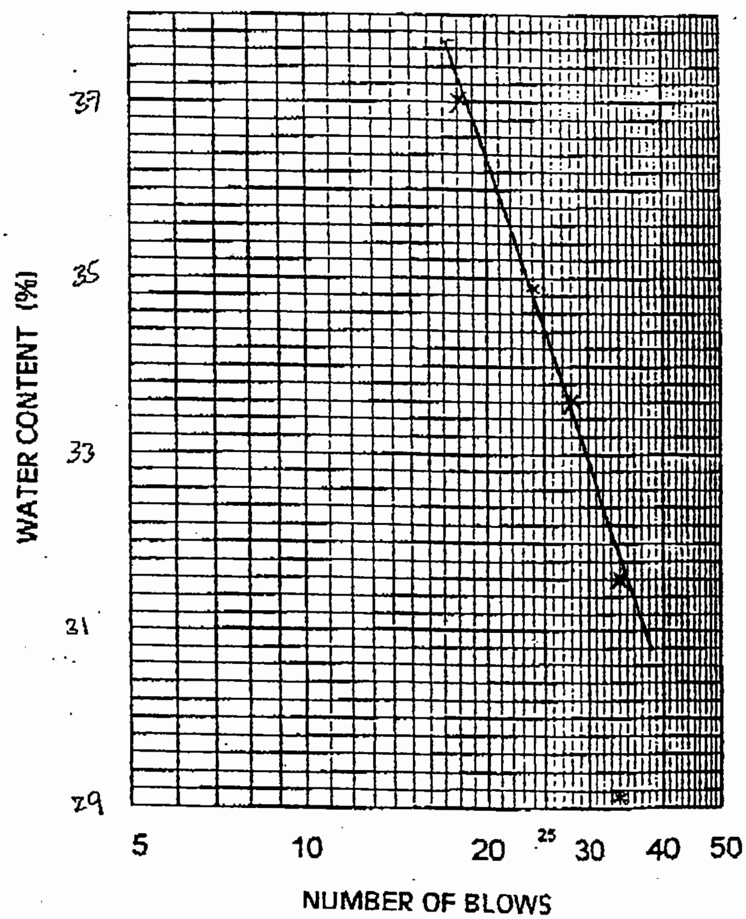
No. OF BLOWS:	34	24	18	28	34
CONTAINER No:	x-4	x-5	x-6	x-10	x-11
WT. WET SOIL + CONT.	38.86	37.95	34.61	35.22	34.59
WT. DRY SOIL + CONT.	34.37	33.80	31.06	31.76	31.31
WT. CONTAINER (g)	21.68	21.90	21.46	21.45	20.92
WATER CONTENT (%)	29.1	34.9	37.0	33.6	31.6

SUMMARY OF RESULTS

NAT. WATER CONTENT:	30.9
LIQUID LIMIT:	33.7
PLASTIC LIMIT:	20.9
PLASTIC INDEX:	12.8

PLASTICITY CHART





BANGOR HYDRO ELECTRIC COMPANY

NORTHEAST RELIABILITY INTERCONNECT

PROPOSED SUBSTATION MODIFICATIONS
FIELDS POND ROAD
ORRINGTON, ME

CLASS C – MEDIUM HIGH INTENSITY SOIL SURVEY

PAUL B. COREY
SOIL CONSULTING
99 BOUTELLE ROAD
BANGOR, MAINE 04401

BANGOR HYDRO ELECTRIC COMPANY
NORTHEAST RELIABILITY INTERCONNECT
PROPOSED SUBSTATION MODIFICATIONS
ORRINGTON, ME

CLASS C - MEDIUM HIGH INTENSITY SOIL SURVEY

TABLE OF CONTENTS

PAUL B. COREY
SOIL CONSULTING

Soil Science - Site Evaluation - Wetland Science - Environmental Permitting
99 Boutelle Road Bangor, ME 04401 (207)945-4302 Fax:(815)461-7413

January 27, 2005

Introduction:

As requested, we have completed a Class C – Medium High Intensity Soil Survey of an approximately 30,000 square foot parcel of land on Fields Pond Road in Orrington, Maine. We understand that the parcel is to be developed as part of modifications to the existing substation in conjunction with the proposed Northeast Reliability Interconnect project.

The purpose of our investigations was to identify, describe and map the major soil types on the site. The accompanying soil survey map illustrates the location, type, and extent of the soils we observed. We understand that this report and map will be used to supplement other information required by the Maine Department of Environmental Protection in their review of this project. The information provided by this survey can also be used to assist in evaluating the overall suitability of the site for development and indicate areas that may require additional measures to overcome existing soil limitations. It should be noted that limitations that are described for the soils observed are based on the proposed use (i.e., residential subdivision), and these soil properties may or may not be limiting for other types of use.

Mapping was conducted in accordance with Maine Association of Professional Soil Scientists Standards for a Class C – Medium High Intensity Soil Survey. Soils were correlated, where possible, to soil series established in the National Cooperative Soil Survey. Mapping was completed based on a minimum delineation size of approximately three acres. That is, within any map unit, no contiguous area larger than the minimum delineation size (i.e., three acres) will be significantly different from the named soils in terms of use and management.

Site Location and Description:

The site is located on Fields Pond Road approximately 0.6 mile east of the intersection of Brewer Lake Road and Fields Pond Road in Orrington. The area of investigation is directly south of, and adjacent to, the existing substation.

The area generally slopes downward from west to east. The majority of the site is nearly level to gently sloping; however, there are areas that are strongly sloping to steep. These steeper areas are man-made and are related to the stormwater collection and detention facilities for the existing substation.

Topographic mapping, provided by SGC Engineering, LLC, indicates that the site has a high elevation of approximately 147 feet in the northwestern portion of the project area, and the low elevation of approximately 130 feet occurs in the southeastern portion of the site.

The site is mostly open field, but there is some tree and shrub growth. It appears that the site was actively farmed in the past. There is an existing stormwater detention pond associated drainage ditches on the property. Two existing gravel driveways provide access to the existing substation from Fields Pond Road.

Exploration:

We conducted site explorations in the project area on December 29, 2004. A total of four test pits were dug by excavator during these explorations. Test pit locations were generally selected based upon observed changes in relief and/or vegetation, which typically are indicative of variations in soil type. Exposed soil profiles in each test pit were examined as to their horizon development, color, texture, consistence, depth to redoximorphic features (mottles), coarse fragment content, and other pertinent soil properties. Subsurface investigation logs, which describe the dominant features observed in each test pit, are contained in Appendix A. Also included in Appendix A is a soil conditions summary table, which provides an overview of the data collected for the test pits examined.

We determined the drainage classification of the soils on the site using criteria described in the *Guidelines for Maine Certified Soil Scientists for Soil Identification and Mapping*, published by the Maine Association of Professional Soil Scientists in 1990 and revised in 2000. In addition, the *Field Indicators for Identifying Hydric Soils in New England, Version 2*, published by the New England Pollution Prevention and Control Commission in 1998, was used for guidance.

Ground Control was established using a topographic map prepared by SGC Engineering, LLC. This map had a scale of 1" = 40' with a one-foot contour interval. Test pits were located using a cloth tape and orientation to control points. Existing site features such as roads, fences, and utility poles were used as control points.

Soil Characteristics:

We observed soils on the site that formed in glaciolacustrine or glaciomarine sediments. The soils we identified are the poorly drained to somewhat poorly drained Swanton soils, and the moderately well drained Elmwood soils. We also observed areas of fill over native soils, or areas where the native soils have been altered extensively, which are identified as Udorthents.

All of the soils observed are very deep to bedrock. The Elmwood and Swanton soils have coarse textured materials in the upper soil layers that are underlain by clayey deposits.

The Udorthents observed have an approximately two foot layer of gravelly fill over approximately two feet of clayey material. This clayey material was underlain by loamy glacial till in the exploration observed.

Soil and Map Unit Descriptions:

The attached soil survey map illustrates our interpretation of the extent, pattern, and location of map units relative to each other and existing site features. Each map unit symbol consists of three letters (e.g., EsB). The first two letters represent the soil series that exist within the area delineated on the map for map unit complexes. The letter identifying the most extensive component of the map unit is given first (e.g., Es – Elmwood-Swanton complex). The third letter in the map unit symbol indicates the surface slope of the area within the map unit (e.g., B - 3 to 8 percent slopes). Each map unit with the same symbol delineates the same soil phase. There may be small areas of slightly differing soils, called inclusions, which exist within the map unit delineated.

Appendix B contains the descriptions of the map units identified within the limits of our survey. Appendix C contains the Official Series Descriptions published by the Natural Resource Conservation Service for each of the major soil types observed. A guide to understanding soil survey interpretations (Appendix D) and a glossary of terms (Appendix E) are also attached. A Summary of Soil Survey Guidelines for Site Location of Development Projects is included in Appendix F.

Summary of Findings:

Based on our findings, it appears that the soils on the site have low to medium potential for the proposed development. This does not mean that these soil limitations cannot be overcome, but they may require special engineering design and construction techniques, as well as additional costs for development and management. In fact, it is likely that the existing substation was constructed on soils with similar limitations. Please refer to Appendix D for information regarding soil interpretations. The major limitations to the proposed development are low bearing strengths, slow percolation rates, the potential for frost action, and the presence of a high seasonal water table.

The soils observed have low bearing capacities for roads, foundations, and structures, and may require special design considerations. Large footings and/or structural fill may be necessary.

The soils observed on site have slow percolation rates. Slow permeability occurs in the substratum in the soils observed. Excess groundwater will have the tendency to move laterally across this layer and should be considered in both the design and construction phases of the project.

The potential for frost action for the soils within the project area is high. This limitation must be considered during the design and construction of roads, underground utilities, and drainage structures for the project. Structural fill will be necessary for road construction and must be properly designed and installed.

The presence of a seasonal high water table observed in the soils on site must be considered during design and construction of the proposed project. This soil feature has implications for nearly all aspects of the development. The fine textured soils will cause problems if worked when wet. Excavations in these soils when high seasonal water tables are present will fill with groundwater quickly and sidewalls will have the tendency to cave. Excavated soil materials will be unsuitable for backfill in the glaciomarine soils due to high clay and moisture content.

As with any development project, the potential for erosion exists any time the soil surface is exposed. Glaciomarine soils are most vulnerable to this process due to their fine textures. It is very important that standard erosion and sediment control measures be installed prior to commencement of site preparation or construction activities. Areas of stockpiled soils should also be protected using appropriate measures. Exposed areas of soils should be revegetated as soon as possible following completion of construction activities, and temporary erosion controls should be removed as soon as the soil surface is permanently stabilized. As noted earlier, Appendix D contains information concerning Soil Survey Interpretations.

Limitations:

The scope of this investigation has been limited to the development of a Class C – Medium High Intensity Soil Survey in general accordance with standards established by the Maine Association of Professional Soil Scientists. This report has been prepared for the exclusive use of Bangor Hydro Electric Company for specific application to the proposed substation modification project in Orrington, Maine. No other warranty, expressed or implied, is made. The conclusions and recommendations presented in this report are based upon our interpretation of the data obtained from the explorations performed at the locations indicated on the Soil Survey Map. This report may not reflect variations that may occur between these explorations.

Paul B. Corey
Certified Soil Scientist
Licensed Site Evaluator

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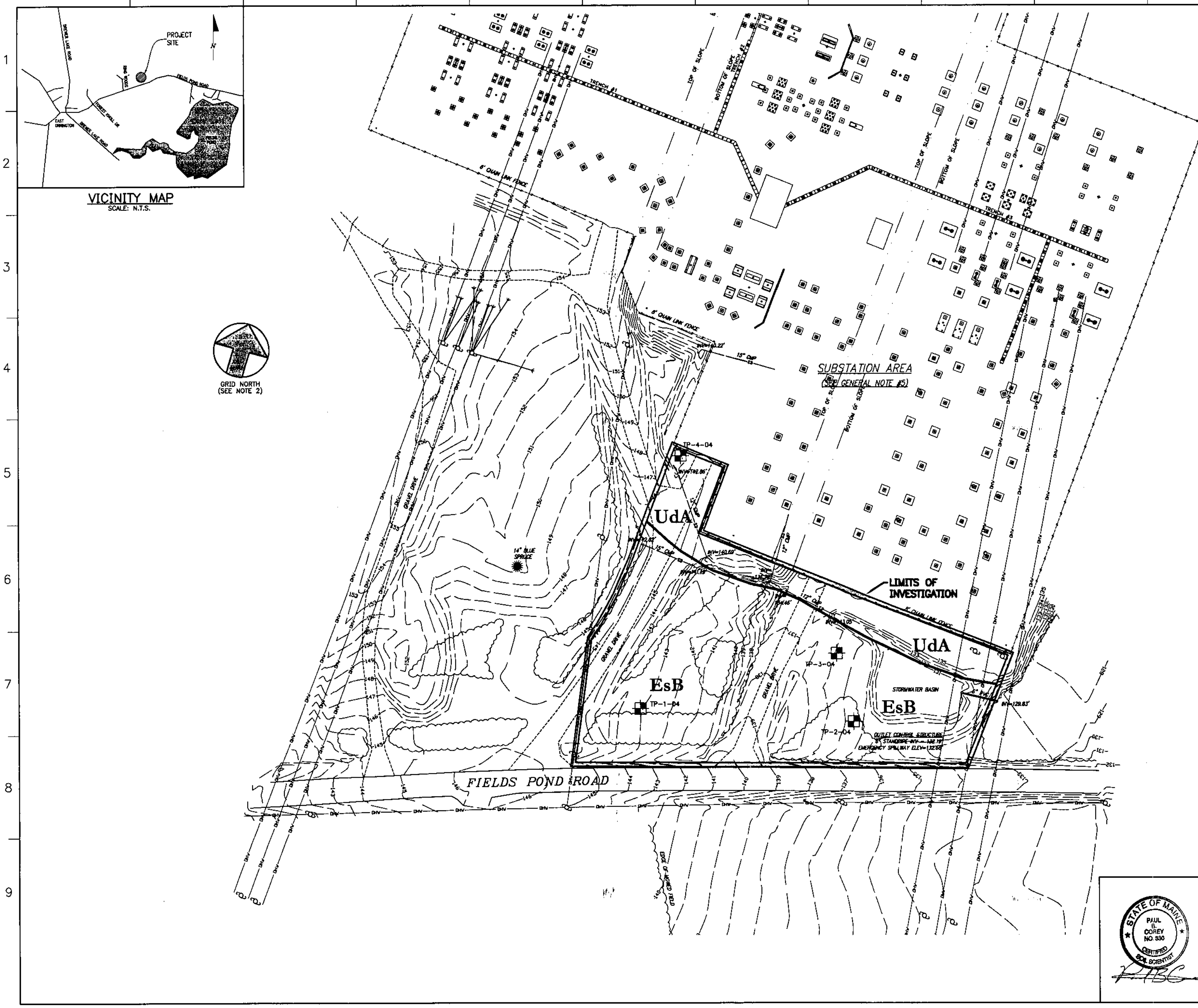
PAUL B. COREY
NO. 330
CERTIFIED SOIL SCIENTIST

STATE OF MAINE
PAUL B. COREY
NO. 265
LICENSED SITE EVALUATOR



GENERAL NOTES:

1. BASED ON SGC ENGINEERING, LLC. DRAWING NO. 187005_OS_TOPO.DWG ENTITLED "LIMITED EXISTING CONDITIONS SURVEY, ORRINGTON, SUBSTATION, FIELDS POND ROAD, TOWN OF ORRINGTON, PENOBSCOT COUNTY, STATE OF MAINE, DATED 11/22/04.
2. NORTH AS SHOWN REFERS TO GRID NORTH AND IS BASED ON THE MAINE STATE COORDINATE SYSTEMS, EAST ZONE.
3. VERTICAL INFORMATION AS SHOWN IS REFERENCED TO NAVD 88.
4. TOPOGRAPHIC AND PLANIMETRIC INFORMATION AS SHOWN IS THE RESULT OF AN ON-THE-GROUND FIELD SURVEY PERFORMED BY SGC ENGINEERING, LLC BETWEEN NOVEMBER 15, 2004 AND NOVEMBER 17, 2004.
5. THE LOCATIONS OF FOOTINGS AND STRUCTURES WITHIN THE FENCED SUBSTATION AREA HAVE BEEN COMPILED BASED ON DESIGN INFORMATION PROVIDED BY BANGOR HYDROELECTRIC COMPANY.
6. WETLANDS AS SHOWN HAVE BEEN DELINEATED BY DEVINE TARBELL & ASSOCIATES.

SOILS NOTES:

1. THIS MAP WAS DEVELOPED TO MEET PART OF THE PERMITTING REQUIREMENTS OF THE MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION. MAPPING WAS CONDUCTED AT A CLASS C – MEDIUM HIGH INTENSITY. THIS MAP SHOULD BE REVIEWED AND INTERPRETED IN CONJUNCTION WITH THE ACCOMPANYING SOIL SURVEY REPORT.
2. SOIL MAPPING WAS CONDUCTED AT A SCALE OF 1" = 40'. A TOPOGRAPHIC SURVEY WITH 1' CONTOUR INTERVALS, DEVELOPED BY SGC ENGINEERING, LLC, WAS USED AS A BASE FOR MAPPING (SEE GENERAL NOTE 1).
3. MACHINE EXCAVATED TEST PITS WERE EXAMINED ON DECEMBER 29, 2004. TEST PITS WERE LOCATED USING A CLOTH TAPE AND ORIENTATION TO CONTROL POINTS. EXISTING SITE FEATURES SUCH AS ROADS, FENCES, AND UTILITY POLES WERE USED AS CONTROL POINTS.
4. SOIL MAPPING WAS CONDUCTED PAUL B. COREY, C.S.S. # 330, IN GENERAL ACCORDANCE WITH SOIL SURVEY STANDARDS ESTABLISHED BY THE MAINE ASSOCIATION OF PROFESSIONAL SOIL SCIENTISTS FOR CLASS C – MEDIUM HIGH INTENSITY SOIL SURVEYS. MAPPING WAS CONDUCTED USING A MINIMUM DELINEATION SIZE OF THREE ACRES OR LESS

GENERAL LEGEND:

	SWALE CENTERLINE
	EDGE OF GRAVEL
	EDGE OF PAVEMENT
	ROAD CENTERLINE
85	GRADE CONTOUR
SD	CULVERT
OHW	OVERHEAD WIRES
CORRUGATED PLASTIC PIPE	CPP
CORRUGATED METAL PIPE	CMP
INVERT	INV.
	UTILITY POLE
	CONIFEROUS TREE
	EDGE OF WOODS/BRUSH
	WETLANDS
TP-2-04	2004 TEST PIT

SOILS LEGEND:

MAP UNIT SYMBOL	MAP UNIT NAME
EsB	ELMWOOD-SWANTON COMPLEX, 3 TO 8 PERCENT SLOPES
UdA	UDORTHENTS, 0 TO 3 PERCENT SLOPES

TOWN OF ORRINGTON MAINE

CLASS C–MEDIUM HIGH INTENSITY SOIL SURVEY MAP–FIELDS POND ROAD

BANGOR HYDRO ELECTRIC COMPANY
BANGOR, MAINE

Paul B. Corey
Soil Consulting
99 Boutelle Road, Bangor, ME. 04401

SCALE: 1"=40'	PROJ. NO. 005.0003.0100 DWG. NO.	REV 0
DATE: 1/26/05	DRAWN SGC/MLN DWG. CHK'D. P.COREY	LEAD ENGR. – PROJ. ENGR. –

APPENDIX A

TEST PIT LOG SUMMARY
&
TEST PIT LOGS

FORM E

SOIL CONDITIONS SUMMARY TABLE

for SUBSURFACE INVESTIGATIONS at DEP SITE LOCATION PROJECTS

Project Name: Northeast Reliability Interconnect	DEP Project #:
Applicant Name: Bangor Hydro Electric Co.	Consultant Name: Paul B. Corey
Project Location *(municipality)*: Orrington	Type of Investigation: Class C – Medium High Intensity Soil Survey

Lot No.	Exploration Symbol *(alph/num)*	✓ or ✗ if at SSWD field	• soil profile/condition *(S.E.)* • soil series name *(C.S.S.)* • geologic unit *(C.G.)* *(as appropriate to the investigation)*	Depths to *(check one)*: X inches cm — Mottling	Bedrock	Restrictive Layer	Ground Surface Slope *(%)*
	TP 1-04		Swanton fine sandy loam	12"	N.O.*	30"	3-8
	TP 2-04		Elmwood fine sandy loam	16"	N.O.	34"	3-8
	TP 3-04		Elmwood fine sandy loam	25"	N.O.	50"	3-8
	TP 4-04		Udorthents	22"	N.O.	22"	0-3

Professional Endorsements *(as applicable)*

S.E.	signature: [signature]	Date: 12/29/04
	name printed/typed PAUL B. COREY	Lic. #: 265
C.S.S.	signature: [signature]	Date: 12/29/04
	name printed/typed PAUL B. COREY	Cert. #: 330
C.G.	signature:	Date:
	name printed/typed:	Cert. #:

affix professional seal

STATE OF MAINE
PAUL B. COREY
NO. 330
SOIL SCIENTIST

* N.O. = NONE OBSERVED

FORM F

SOIL PROFILE/CLASSIFICATION INFORMATION

for subsurface investigations at DEP Site Location Projects

ect Name:	Applicant Name:	Project Location (municipality):
THEAST RELIABILTY INTERCONNECT	BANGOR HYDRO ELECTRIC CO.	ORRINGTON

Soil Description and Classification

Exploration Symbol: TP 1-04 ■ Test Pit ☐ Boring

1" Depth of Organic Horizon Above Mineral Soil

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0"				
6"	F.S. LOAM	FRIABLE	BROWN	NONE
12"			DK. YEL. BROWN	
18"	LOAMY	LOOSE		
24"	SAND		OLIVE	MANY
30"			BROWN	
36"	SILTY	FIRM		PROMINENT
42"	CLAY		OLIVE	
48"	LOAM			
54"				
60"	SILTYCLAY	VERY FIRM	OLIVE GRAY	
66"	LIMIT OF OBSERVATION @ 12' IN DEPTH			

	Soil Class.	Slope %	Limiting factor	
S.E.	7 D Prof/Cond	3-8	12"	■ ground water ☐ restrictive layer ☐ bedrock
C.S.S.	Soil Series / phase name: Swanton fine sandy loam			☐ hydric ■ non-hydric

Soil Description and Classification

Exploration Symbol: TP 2-04 ■ Test Pit ☐ Boring

<1" Depth of Organic Horizon Above Mineral Soil

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0"				
6"	FINE		BROWN	
12"	S. LOAM	FRIABLE		NONE
18"			DK. YEL. BROWN	
24"	LOAMY	LOOSE	LT. OL. BRN.	
30"	FINE SAND			
36"	FINE SAND		OLIVE	MANY
42"	SI. CLAY	FIRM	OLIVE	
48"	LOAM		GRAY	PROMINENT
54"				
60"	SI. CLAY	VERY FIRM	LT. OL. GRAY	
66"	LIMIT OF OBSERVATION @ 13' IN DEPTH			

	Soil Class.	Slope %	Limiting factor	
S.E.	7 C Prof/Cond	3-8	16"	■ ground water ☐ restrictive layer ☐ bedrock
C.S.S.	Soil Series / phase name: Elmwood fine sandy loam			☐ hydric ■ non-hydric

Soil Description and Classification

Exploration Symbol: TP 3-04 ■ Test Pit ☐ Boring

<1" Depth of Organic Horizon Above Mineral Soil

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0"				
6"	FINE		BROWN	
12"	S. LOAM	FRIABLE		NONE
18"	LOAMY		STRONG	
24"	FINE SAND		BROWN	
30"				
36"	FINE	LOOSE	LT. OL. BRN.	MANY
42"	SAND		OLIVE BRN.	
48"			OLIVE	PROMINENT
54"				
60"	SI. CLAY	VERY FIRM	OLIVE GRAY	
66"	LIMIT OF OBSERVATION @ 78" IN DEPTH			

	Soil Class.	Slope %	Limiting factor	
S.E.	7 C Prof/Cond	3-8	25"	■ ground water ☐ restrictive layer ☐ bedrock
C.S.S.	Soil Series / phase name: Elmwood fine sandy loam			☐ hydric ■ non-hydric

Soil Description and Classification

Exploration Symbol: TP 4-04 ■ Test Pit ☐ Boring

<1" Depth of Organic Horizon Above Mineral Soil

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0"				
6"	VERY			
12"	GRAVELLY	LOOSE	OLIVE	NONE
18"	SAND (FILL)		BROWN	
24"				
30"	SILTY	VERY	OLIVE	
36"	CLAY	FIRM		MANY
42"				
48"	GRAVELLY		OLIVE	PROMINENT
54"	F. SANDY	FIRM	BROWN	
60"	LOAM			
66"	LIMIT OF OBSERVATION @ 75" IN DEPTH			

	Soil Class.	Slope %	Limiting factor	
S.E.	7 C Prof/Cond	0-3	22"	■ ground water ■ restrictive layer ☐ bedrock
C.S.S.	Soil Series / phase name: Udorthents			☐ hydric ■ non-hydric

Professional Endorsements *(as applicable)*

S.E.	signature:		Date:	12/29/04
	name:	Paul B. Corey	Lic. #:	265
S.	signature:		Date:	12/29/04
	name:	Paul B. Corey	Lic. #:	330

affix professional seal

STATE OF MAINE
PAUL B. COREY
NO. 330
CERTIFIED SOIL SCIENTIST

APPENDIX B

SOIL MAP UNIT DESCRIPTIONS

SOILS LEGEND

MAP UNIT SYMBOL	MAP UNIT NAME
EsB	Elmwood - Swanton complex, 3 to 8 percent slopes
UdA	Udorthents, 0 to 3 percent slopes

EsB – Elmwood - Swanton complex, 3 to 8 percent slopes

The soils in this map unit are gently sloping and very deep. These soils formed in thin mantle of loamy outwash material over clayey marine or lacustrine deposits. Elmwood soils are moderately well drained. Swanton soils are poorly drained to somewhat poorly drained. This map unit is found throughout the southern and central portions of the site.

In a typical area, this map unit consists of 40 percent Elmwood fine sandy loam, 40 percent Swanton fine sandy loam, and 20 percent other soils. The major inclusions are Udorthents, 0 to 3 percent slopes; and Udorthents, 15 to 40 percent slopes.

Elmwood soils typically have a surface layer of brown fine sandy loam that is 12 inches thick. The upper subsoil is 13 inches of strong brown loamy fine sand over mottled light olive brown fine sand to a depth of 36 inches. The lower subsoil is 6 inches of mottled olive brown fine sand over 8 inches of mottled olive fine sand. The substratum is firm, mottled olive gray silty clay to 72 inches in depth. Depth to bedrock is greater than 72 inches.

Permeability in Elmwood soils is moderately rapid in the loamy mantle and slow or very slow in the clayey substratum. Hydrologic group is C. The K-Factor in these Elmwood soils is .28. Flooding frequency class is none. Surface runoff is medium to high. The potential for frost action is high.

Swanton soils typically have a surface layer of brown fine sandy loam that is 9 inches thick. The subsoil is 3 inches of dark yellowish brown fine sandy loam over 18 inches of mottled olive brown loamy sand to a depth of 30 inches. The substratum is 20 inches of firm mottled olive silty clay loam over very firm, mottled olive gray silty clay to 72 inches in depth. Depth to bedrock is greater than 72 inches.

Permeability in Swanton soils is moderately rapid in the loamy mantle and slow or very slow in the clayey substratum. Hydrologic group is C/D. The K-Factor in these Swanton soils is .28. Flooding frequency class is none. Surface runoff is medium to high. The potential for frost action is high.

These soils are a mixture of fields and forest. The main limitations for use of these soils are shallow depth to a seasonal high water table, slow permeability in the lower horizons, low bearing strength, and the high potential for frost action.

UdA - Udorthents, 0 to 3 percent slopes

Udorthents consist of fill material over soil, or the original soil has been altered to the extent that classification as a soil series is not possible. The fill material may be highly variable in thickness and in origin, and may range from silty clay to extremely gravelly sand.

In the test pit examined, the surface layer is 22 inches of olive very gravelly sand. The substratum is 21 inches of very firm, mottled olive silty clay over firm, mottled olive brown gravelly fine sandy loam to 72 inches in depth. Depth to bedrock is greater than 72 inches.

Most of these areas are not vegetated. Small areas that have not been altered may be included within this map unit. This map unit occurs in the northern portion of the site adjacent to the existing substation. These areas are nearly level. Included in this map unit are Udorthents, 15 to 40 percent slopes.

The characteristics of these areas are extremely variable, and use and management interpretations must be made on a site-specific basis.

APPENDIX C

OFFICIAL SOIL SERIES DESCRIPTIONS

LOCATION ELMWOOD ME+MA NH NY VT

Established Series
Rev. KJL-JAF-WDH
01/2000

ELMWOOD SERIES

The Elmwood series consists of very deep, moderately well drained soils that formed in a thin mantle of loamy outwash materials over clayey marine or lacustrine deposits on lake and marine plains, and outwash plains and deltas. Permeability is moderately rapid in the loamy mantle and slow or very slow in the clayey substratum. Slope ranges from 0 to 25 percent. Mean annual temperature is about 45 degrees F, and mean annual precipitation is about 43 inches at the type location.

TAXONOMIC CLASS: Coarse-loamy over clayey, mixed over illitic, superactive, frigid Aquic Dystric Eutrudepts

TYPICAL PEDON: Elmwood fine sandy loam - grassland. (Colors are for moist soil)

Ap--0 to 9 inches; dark brown (10YR 4/3) fine sandy loam; moderate fine granular structure; friable; many grass roots; moderately acid; abrupt smooth boundary. (6 to 10 inches thick)

Bw1--9 to 16 inches; yellowish brown (10YR 5/6) sandy loam; weak fine granular structure; friable; common roots; moderately acid; clear wavy boundary. (3 to 9 inches thick)

Bw2--16 to 21 inches; light olive brown (2.5Y 5/6) sandy loam; massive; friable; few roots; common medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; moderately acid; clear wavy boundary. (5 to 15 inches thick)

Eg--21 to 23 inches; olive gray (5Y 5/2) sandy loam; massive; friable; common medium prominent dark yellowish brown (10YR 4/4) masses of iron accumulation; moderately acid; abrupt wavy boundary. (0 to 7 inches thick)

2Bw--23 to 31 inches; pale olive (5Y 6/3) silty clay loam; moderate fine subangular blocky structure; firm; few films of clay or silt on vertical faces of peds and very few on horizontal faces; thin films of silt and clay in root channels and pores; common medium prominent yellowish brown (10YR 5/8) masses of iron accumulation; slightly acid; clear wavy boundary. (0 to 10 inches thick)

2C--31 to 65 inches; olive (5Y 4/3) silty clay loam; greenish gray (5GY 6/1) faces of peds; moderate medium and thick platy structure; firm; manganese stains on faces of peds; thin discontinuous films of fine silt on all faces; slightly acid.

TYPE LOCATION: Sagadahoc County, Maine; Town of Topsham; along Maine Route 24, about one-half mile south of the cemetery; USGS Brunswick, ME topographic quadrangle; latitude 43 degrees, 56 minutes, 22 seconds N., longitude 69 degrees, 53 minutes, 03 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Depth to the underlying fine-textured material ranges dominantly from 20 to 40 inches with a few pedons ranging to 18 inches. Depth to bedrock is more than 60 inches. The coarse-loamy material has 0 to 3 percent rock fragments and the clayey material lacks rock fragments. Reaction ranges from very strongly acid to slightly acid above the lithologic discontinuity and from moderately acid to slightly alkaline below. Thin horizons of loamy sand or loamy fine sand occur in some pedons above the lithologic discontinuity.

The Ap, or A horizon where present, has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. It is very fine sandy loam, fine sandy loam, sandy loam or loam. It has weak or moderate fine granular structure. Consistence is very friable or friable.

The Bw horizon has hue of 5YR to 2.5Y, value of 3 to 5, and chroma of 3 to 6. It is fine sandy loam, sandy loam or loam except thin layers of loamy sand or loamy fine sand are allowed. It has weak or moderate very fine or fine granular or subangular blocky structure or it is massive. Consistence is very friable or friable.

The Eg horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 2 to 4. It is sandy loam, fine sandy loam, very fine sandy loam or silt loam. It has weak thin to thick platy structure that may part to subangular blocky, or the horizon is massive.

The 2Bw horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 2 to 4. It is clay loam, silty clay loam, or silty clay. It has weak or moderate, very fine to medium subangular blocky structure.

The 2C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 2 to 4. It is clay loam, silty clay loam, silty clay, or clay. Some pedons have thin strata of coarser material ranging from sand to silt below a depth of 40 inches. It has weak or moderate, very fine to medium subangular blocky, moderate medium to very thick platy, or prismatic structure that parts to blocky, or the horizon is massive. Thin films of silt or clay are present on faces of peds in some pedons. Some pedons have manganese stains on faces of peds in the lower part of the horizon.

COMPETING SERIES: Elmwood is currently the only series in this family. Eldridge soils are similar but have a mesic temperature regime.

GEOGRAPHIC SETTING: Elmwood soils are on glaciolacustrine, marine or outwash plains and deltas. Slope ranges from 0 to 25 percent. These soils formed in loamy outwash or lacustrine materials underlain by fine-textured lacustrine or marine deposits. The climate is humid and cool temperate. Mean annual temperature ranges from 43 to 46 degrees F, and the mean annual precipitation ranges from 38 to 55 inches. The frost-free season ranges from 130 to 190 days. Elevation ranges from 5 to 900 feet above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Adams, Allagash, Biddeford, Buxton, Lamoine, Madawaska, Melrose, Scantic, Suffield, Swanton, and Whately series. Adams, Allagash and Madawaska soils do not have the fine-textured substratum and are in similar or higher positions on the landscape. Biddeford and Whately soils are very poorly drained soils in depressions. Buxton, Lamoine, Scantic and Suffield soils do not have the coarse-loamy mantle. Melrose soils are well drained and in higher positions on the landscape. Swanton soils are somewhat poorly drained and poorly drained soils in lower positions on the landscape.

DRAINAGE AND PERMEABILITY: Moderately well drained. Permeability is moderately rapid in the loamy mantle and slow to very slow in the clayey substratum.

USE AND VEGETATION: Most areas of this soil are used for hay and pasture with a small amount used for growing row crops and woodland. Common tree species are white pine, red oak, hemlock, sugar maple, beech, elm, gray birch and white birch.

DISTRIBUTION AND EXTENT: Maine, Massachusetts, New Hampshire, Vermont, and eastern New York; MLRA'S 101, 141, 142, 143, 144A, 144B and 145 (SEE REMARKS). The soil is of moderate extent.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Connecticut Valley Survey, 1903.

REMARKS: 1. Elmwood soils were mapped and correlated as mesic soils prior to 1979. They were subsequently reclassified as having a frigid temperature regime and are now restricted to frigid areas. Its use in MLRA's 101, 144A, and 145 will be restricted. The Elmridge series is the mesic counterpart to Elmwood. 2. Diagnostic horizons and features recognized in this pedon are:
a. Ochric epipedon - the zone from 0 to 9 inches (Ap horizon).
b. Cambic horizon - the zone from 9 to 31 inches (Bw1, Bw2 Bg, and 2Bw horizons).
c. Aquic conditions - redox features within 24 inches of the mineral soil surface.

ADDITIONAL DATA: Soil Interpretation Record Numbers for the Elmwood series are: Elmwood, ME004; and Elmwood Very Stony Variant, ME0053.

National Cooperative Soil Survey
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LOCATION SWANTON ME+MA NH NY OH VT

Established Series
Rev. JAF-KJL-WDH
5/98

SWANTON SERIES

The Swanton series consists of very deep, somewhat poorly drained and poorly drained soils that formed in a thin mantle of loamy outwash materials over clayey marine or lacustrine deposits on lake and marine plains, and outwash plains and deltas. Slope ranges from 0 to 8 percent. Permeability is moderately rapid in the loamy mantle and slow or very slow in the clayey substratum. Mean annual temperature is about 43 degrees F, and mean annual precipitation is about 42 inches at the type location.

TAXONOMIC CLASS: Coarse-loamy over clayey, mixed over illitic, superactive, nonacid, frigid Aeric Epiaquepts

TYPICAL PEDON: Swanton fine sandy loam on a 1 percent slope in a hayfield. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 7 inches; very dark gray (10YR 3/1) fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak fine granular structure; friable; many roots; strongly acid; abrupt smooth boundary. (5 to 9 inches thick)

Bg1--7 to 10 inches; grayish brown (10YR 5/2) fine sandy loam; weak fine granular structure; friable; common roots; few medium distinct yellowish brown (10YR 5/4) masses or iron accumulation; strongly acid; abrupt wavy boundary. (2 to 8 inches thick)

Bg2--10 to 18 inches; grayish brown (2.5Y 5/2) fine sandy loam; weak fine granular structure; friable; few roots; few medium prominent yellowish brown (10YR 5/6) masses of iron accumulation; strongly acid; abrupt smooth boundary. (6 to 14 inches thick)

Eg--18 to 22 inches; light brownish gray (2.5Y 6/2) sandy loam; weak thick platy structure; friable; many coarse distinct olive brown (2.5Y 4/4) masses of iron accumulation; strongly acid; abrupt smooth boundary. (0 to 10 inches thick)

2Cg1--22 to 30 inches; olive (5Y 5/3) silty clay loam; moderate medium subangular blocky structure; firm; thin films and dark stains on peds; films of olive gray (5Y 5/2) on faces of peds; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation on interiors of peds; slightly acid; clear wavy boundary. (0 to 10 inches thick)

2Cg2--30 to 40 inches; olive (5Y 4/3) silty clay; weak medium platy structure parting to moderate very fine angular blocky; firm; few films in pores and on faces of peds; black stains on faces of peds; films of light gray (5Y 7/2) and few fine distinct light olive brown (2.5Y 5/4) masses of iron accumulation on faces of peds; slightly acid; gradual wavy boundary. (0 to 12 inches thick)

2Cg3--40 to 65 inches; olive (5Y 4/3) silty clay; weak very thick platy inherited structure; firm; few dark gray (5Y 4/1) films on faces of peds; slightly acid.

TYPE LOCATION: Androscoggin County, Maine; Town of Durham; 1200 feet northeast of the intersection of Maine Route 136 and Quaker Meeting House Road; USGS Lisbon Falls South topographic quadrangle; about lat. 43 degrees 57 minutes 2 seconds N. and long. 70 degrees 7 minutes 3 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Depth to the underlying fine-textured material ranges dominantly from 20 to 40 inches with a few pedons ranging to 18 inches. Depth to bedrock is more than 60 inches. Consistence is very friable or friable in the coarse-loamy mantle and are absent below. Reaction ranges from strongly acid to neutral in the coarse-loamy mantle and from moderately acid to moderately alkaline below.

The Ap horizon, or A horizon where present, has hue of 7.5YR to 2.5Y, value of 2 to 4, and chroma of 1 or 2. It is very fine sandy loam, fine sandy loam, or sandy loam. It has weak or moderate, very fine to medium granular structure.

The Eg horizon, where present, has hue of 10YR to 5Y, value of 5 or 6, and chroma of 2. It is very fine sandy loam, fine sandy loam, or sandy loam. It has weak or moderate, very fine to medium granular structure.

The B horizon has hue of 7.5YR to 5Y, value of 3 to 6, and chroma of 1 to 4 and has distinct and prominent redox concentrations. It is fine sandy loam or sandy loam, but some pedons have thin loamy fine sand subhorizons. It has weak, very fine or fine granular or moderate medium subangular blocky structure.

The E' horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 or 3 and has faint to prominent redox concentrations. The E' horizon is fine sandy loam or sandy loam, but some pedons where the horizon is thin are loamy fine sand. It has weak fine granular or weak or moderate, thin to thick platy structure.

The 2C horizon has hue of 10YR to 5GY, value of 4 to 6 and chroma of 0 to 4. Redox concentrations are faint to prominent, but may be absent in the lower part. The 2C horizon is silty clay loam, silty clay, or clay. It has weak or moderate, thin to very thick platy or weak or moderate, very fine to medium subangular or angular blocky structure, all of which is inherited from the parent material, or the horizon is massive.

COMPETING SERIES: Swanton is currently the only series in this family. Gogomain soils are in a closely related family from outside of Region R. They have free carbonates within a depth of 60 inches and receive less annual precipitation.

GEOGRAPHIC SETTING: Swanton soils are in depressional areas on marine and lake plains, outwash plains, or deltas. Slope ranges from 0 to 8 percent. The soils formed in loamy outwash or lacustrine deposits underlain by fine-textured lacustrine and marine deposits. The climate is humid and cool temperate. The mean annual temperature ranges from 40 to 46 degrees F, and the mean annual precipitation ranges from 36 to 48 inches. The frost-free season ranges from 90 to 160 days. Elevation ranges from 5 to 900 feet above mean sea level.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Adams, Buxton, Elmwood, Lamoine, Melrose, Scantic and Whately soils are sandy and are better drained. Buxton, Lamoine and Scantic soils have a finer-textured mantle. Elmwood and Melrose soils are better drained. Whately soils are very poorly drained.

DRAINED AND PERMEABILITY: Somewhat poorly drained and poorly drained. Permeability is moderately rapid in the coarse-loamy mantle and slow or very slow in the clayey substratum.

USE AND VEGETATION: Cleared areas are used mainly for hay and pasture and some row crops. The remaining areas are mostly forested and the common tree species are eastern white pine, white spruce, and red spruce. Hemlock, gray birch, red maple, sugar maple, balsam fir, and tamarack also are present to a lesser extent.

DISTRIBUTION AND EXTENT: Maine, Massachusetts, Connecticut, New Hampshire, New York, Ohio* and Vermont. (MLRA's 100,* 101,* 142, 143, 144A, 144B.) The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Essex County, New York, 1954.

REMARKS: 1. *Swanton soils have a frigid temperature regime and will not be maintained in MLRA 100 and 101 when these areas are updated. 2. Diagnostic horizons and features recognized in this pedon are:
a. Ochric epipedon - the zone from 0 to 7 inches (Ap horizon).
b. Cambic horizon - the zone from 7 to 18 inches (Bg1 and Bg2 horizons).
c. Aquic conditions - redoximorphic features at 7 inches.

ADDITIONAL DATA: The Soil Interpretation Record Number for the Swanton series is ME0017.

National Cooperative Soil Survey
U.S.A.

APPENDIX D

GUIDE TO SOIL SURVEY INTERPRETATIONS

Soil Survey Interpretations

Introduction

Soil survey interpretations are predictions of soil behavior under stated conditions. Predicting soil behavior can help us estimate the nature, extent, and amount of cost that will be incurred by a proposed development. Soil interpretations, for a specific parcel of land, infer reasonable alternatives for using and managing the existing soils and the anticipated results. They are based on the inherent soil characteristics of a site that can potentially affect a proposed project. Soil interpretations are developed for a variety of land uses, individual cultural practices, and resource management plans.

In the National Cooperative Soil Survey, soils are classified according to their natural properties that control a soils response to a specific use, alteration, or disturbance. Once the taxonomic name is given to a soil, many types of interpretations are possible based on that classification. It is important to remember when rating soils for a particular use that soil characteristics can be modified by engineers or other professionals to overcome their limiting factors, although this endeavor can be costly.

Soil survey interpretations are usually expressed in two ways: soil limitation ratings and soil potential ratings.

Soil Limitation Ratings

Soil interpretations are often expressed by degree of limitation. Soils are evaluated in their natural state and exclusively for a specified use. Therefore, no unusual modification or disturbance of the soils or other site features are considered in determining their rating. Only the most restrictive characteristics are listed. Soils are given limitation ratings of slight, moderate, severe, or very severe.

<u>Slight</u> is the rating given to soils that have properties favorable for a particular use.

<u>Moderate</u> is the rating given soils that have properties moderately favorable for that use. This degree of limitation can be overcome or modified by special planning, design, or maintenance.

<u>Severe</u> is the rating given to soils that have one or more properties unfavorable for the specific use, such as steep slopes, shallow depth to bedrock, frequent flooding, high water table, etc. This degree of limitation generally requires special design or maintenance.

Very Severe implies that one or more characteristics of the soil are so unfavorable for the intended use that the limitations are very difficult and costly to overcome. A very severe rating means that the soils require extreme alteration for that project and are typically not used.

Soil Potential Ratings

Soil potential ratings have been developed as another form of soil interpretations. These ratings reflect the potential of use rather than the limitations of use and are designed to meet local needs and considerations. Factors considered in preparing soil potential ratings are the feasibility of using certain technology and practices to overcome limiting factors and the relative cost of implementing the practices and the adverse effects and costs of any continuing limitation during the projected lifetime of use. Soil potential ratings are divided into five categories: very high, high, medium, low, and very low.

Very High Potential – Site conditions and soil properties are favorable. Installation costs are the lowest for that use and there are no soil limitations.

High Potential - Site conditions and soil properties are not as favorable as the reference soil condition. The costs for overcoming soil limitations are slightly higher than those for soils with a very high potential rating.

Medium Potential - Site conditions and soil properties are below the reference soil condition. The costs for overcoming soil limitations are signicantly higher than those for soils with a very high potential rating.

Low Potential - Site conditions and soil properties are significantly below the reference soil condition. The costs of measures required to overcome soil limitations are very high.

Very Low Potential – There are severe soil and site conditions for which economical corrective measures are prohibitive or unavailable and costs of these measures are extremely high. Also, soil limitations which detract from environmental quality may continue even after installation of corrective measures.

Soil Properties and Site Features May Affect Development Cost

Once the suitability of a soil is determined, specific analysis of the soil's properties and site features can be made to help estimate development costs.

The following is a brief discussion of some major soil characteristics that influence soil suitability, soil potential, and, ultimately, development costs:

1. Depth to Bedrock

Bedrock is the solid (fixed) rock underlying soils. "Soft" rock is likely to be sufficiently soft, thinly bedded, or fractured so that excavation can be made with trenching machines, backhoes, or small rippers and other common construction equipment. "Soft" rock phenomenon is common in some sedimentary bedrock. "Hard" rock is likely to be sufficiently hard or massive to require blasting or special equipment beyond what is considered normal for this type of construction.

Depth to bedrock is a critical soil property. Bedrock at shallow depths limits plant growth because of restricted root penetration and lower available water capacity. The hardness and continuity of bedrock influence the ease of excavation, which is significant for most construction projects. The hardness, continuity, and configuration of bedrock commonly impede the downward movement of water, which is critical for building construction, subsurface wastewater disposal systems, and many other uses.

2. Depth to Seasonally High Water Table

A seasonally high water table is a zone of saturation at the highest average depth during the wettest season. It is at least 6 inches thick, persists in the soil for more than a few weeks, and is within 6 feet of the soil surface.

Soils that have a seasonally high water table are classified according to depth to the water table, type of water table, and time of year when the water table is at its highest level.

The three types of seasonally high water tables recognized within soils are apparent, perched, and artesian. Another type is located above the soil surface most of the time causing ponding.

Depth to a seasonally high water table is significant for plant growth, subsurface wastewater disposal, and construction requiring excavation on or in that zone of saturation.

3. Depth to a Restrictive Layer

A restrictive layer is a nearly continuous layer of firm to indurated or cemented material. The cementing substances binding the soil particles together may include oxides of iron or aluminum. In some instances soils have a restrictive layer that has been compacted in place by the action of ice and/or water, or one that has developed due to continuous cultivation with heavy equipment.

"Thin" is thin enough so that excavation can be made with a backhoe, small rippers, or similar light-duty equipment common to construction of small buildings. "Thick" is sufficiently thick to require blasting or special equipment beyond which is considered normal.

Restrictive layers at shallow depths limit plant growth because of impeded root penetration and the lower available water capacity. The thickness and continuity of restrictive layers influence the ease of excavation. The hardness, continuity, and thickness of restrictive layers affect the downward movement of water in the soil profile. The presence of a restrictive layer commonly results in a seasonal high water table and its associated impacts. It may be feasible to excavate and remove a "thin" restrictive layer to improve soil drainage. A "thick" restrictive layer may require excavation or filling or both.

4. Soil Texture

Soil texture indirectly influences other important soil properties such as soil pH, soil permeability, shrink-swell potential, and water and wind erosion. Soil texture that is "too fine" or "too coarse" may affect soil suitability during and following construction. Where textures are unsuitable for the proposed use or management, removal of the existing soil and filling with appropriate material is commonly recommended.

5. Soil Slope

Slope influences the retention and movement of water, transfer of heat, movement of soil material, rate and amount of runoff, potential for soil slippage and accelerated erosion, ease with which machinery can be used, soil-water state, and perhaps other factors. None of the above processes are a function of slope alone. The significance of a soil's slope must be assessed in relation to other properties of the soil, the immediate environment, and the proposed land use or management. Soil slope can be changed by cut and fill operations where other soil properties do not limit excavation.

6. Flooding

The susceptibility of soils to flooding is an important consideration for homes, building sites, sanitary facilities, and the like. Floods may be less costly per unit area of farmland, but loss of crops and livestock can also be disastrous. For construction, the hazard of flooding may have significant regulatory considerations that eliminate or reduce development options. One example of this is the exclusion of subsurface wastewater disposal systems below the 10-year floodplain elevation.

APPENDIX E

GLOSSARY OF TERMS

Glossary of Terms

Depth Classes

Term	Inches to Bedrock
Very shallow	Less than 10
Shallow	10 to 20
Moderately deep	20 to 40
Deep	40 to 60
Very deep	Greater than 60

Drainage Classes

Drainage Class refers to the frequency and duration of periods of saturation or partial saturation. Seven classes of soil drainage are recognized:

Excessively drained - Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some have steep slopes. All are free of the mottling related to wetness.

Somewhat Excessively drained - Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy, with rapid permeability. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained - Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season. Wetness does not limit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained - Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only short periods during the growing season. This brief wetness is commonly due to the presence of a slowly pervious layer within or directly below the solum, or because these soils recently received high rainfall, or both.

Somewhat poorly drained - Water is removed slowly enough to make the soil wet for significant periods during the growing season. Somewhat poorly drained soils are commonly wet due to the presence of a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or some combination of these factors.

Poorly drained - Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long period. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained - Water is removed from these soils so slowly that free water remains at or on the surface during most of the growing season. They are commonly level or depressed and are frequently ponded. Where rainfall is high and nearly continuous, these soils can still have a significant slope gradient.

Permeability

Permeability is a characteristic of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that the water moves downward through the saturated soil. Terms describing permeability are:

Very slow	Less than 0.06
Slow	0.06 to 0.20
Moderately slow	0.2 to 0.6
Moderate	0.6 to 2.0
Moderately rapid	2.0 to 6.0
Rapid	6.0 to 20
Very rapid	More than 20

Surface Runoff

Surface runoff is the water that flows away from the soil over its surface without infiltrating. The water may come from precipitation or run-on from adjacent areas. The rate and amount of runoff are determined by internal and external characteristics of the soil, climate, and plant cover. Differences in runoff can also be caused by differences in topography and rainfall intensity. Soils usually have a high rate of runoff when frozen.

Six classes of runoff rates are recognized:

Negligible - Little or none of the precipitation and run-on escapes as runoff. Free water stands on the surface for significant periods of time. The amount of water that must be removed from ponded areas by percolation into and through the soil, by plants, or by evaporation is usually greater than the total rainfall. Ponding normally occurs on level to nearly level soils in depressions or concave positions of the microrelief. Water depth may fluctuate greatly.

Very low - Surface Water flows away slowly, and free water stands on the surface for extended periods or immediately enters the soil. Most of the water that passes through the soil is used by plants or evaporates. These soils are commonly level to nearly level or are very open and porous.

Low - Surface water flows away slowly enough so that free water stands on the surface for moderate periods or enters the soil rapidly. Most of the water that passes through the soil is used by plants or evaporates. The soils are nearly level to gently sloping, or they are steeper and absorb precipitation very rapidly.

Medium - Surface water flows away fast enough so that free water stands on the surface for only short periods. Part of the precipitation enters the soil and is used by plants, lost by evaporation, or moves into underground channels. The soils are nearly level to gently sloping and absorb precipitation at a moderate rate, or they are steeper and absorb water rapidly.

High - Surface water flows away fast enough so that the period of concentration is brief and free water does not stand on the surface. Only a small portion of the water enters the soil. The soils are mainly moderately steep or steep and have moderate to slow rates of absorption.

Very high - Surface water flows away so fast that the period of concentration is very brief and free water does not stand on the surface. Only a small portion of the water enters the soil. The soils are mainly steep or very steep and absorb precipitation slowly.

Additional Terms:

Complex - A map unit that consists of areas of two or more kinds of soils that are in a consistently repeating pattern so intricate that the components cannot be delineated separately at the scale of mapping selected.

Dissimilar soil - A soil that either does not have the same limiting diagnostic properties as the named soil(s) or has different use and management requirements. Whether or not a dissimilar soil is considered limiting or non-limiting depends on interpretations for the proposed use.

Flooding - Flooding is the temporary covering of soil surface by flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources. Shallow water standing or flowing during or shortly after rain or snowmelt, is excluded from the definition of flooding. Standing water (see Ponding), or water that forms a permanent cover, is excluded from this definition. Flooding hazard is expressed by frequency classes, duration classes, time of year flooding occurs. Also important, are velocity and depth of floodwater.

Hydric soil - A soil that in its undrained condition is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation. A list of hydric soils has been developed by the National Technical Committee for Hydric Soils and Soil Conservation Sexvice to be used in classifying wetlands.

Hydrolocgic group - There are four groupings of soils (A-D), used for watershed planning to estimate runoff from rainfall. Grouping is based on properties of a soil that influence the minimum rate of infiltration including, depth to the seasonally high water table, intake rate and permeability after prolonged wetting, and depth to any restrictive layer.

Hydrophytic vegetation - Plant life growing in water or a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

Inclusions - Soils or types of miscellaneous areas that are not identified in the map unit name. Many of these areas are too small to be delineated or are simply not observed by practical field methods.

K-factor - A measure of the susceptibility of soil to particle detachment and transport by rainfall. It is a quantitative value determined experimentally.

Map unit - A collection of soil areas delineated during mapping that may encompass more than one soil type. It is evaluated and defined based on specific diagnostic soil properties. A map unit is named for its principal soil components. Each delineated area on a map contains a symbol that represents the map unit name (soil phase and slope).

Mottling - Spots or blotches of color noticeably different from the soil matrix color. The location, size, abundance, and contrast of mottles is often used to infer drainage characteristics of the soil. Drainage mottles should not be confused with relic mottles, which relate to conditions entirely different from those that exist today.

Ortstein - An indurated layer in the B horizon (subsoil) of a soil profile that is cemented by iron and aluminum compounds and organic matter.

Perched water table - The surface of a local zone of saturation held above the main body of groundwater by an impermeable layer. A perched water table is separated from the main body of groundwater by an unsaturated zone.

Pemeability - The ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil.

Ponding - Ponding is standing water in a closed depression. The water is removed only by percolation, transpiration, or evaporation.

Similar soil - A soil that behaves and responds in a similar manner, and shares much the same limitations, as the soils named in the map unit. It has similar conservation needs and management requiremnts.

Solum - The upper, most weathered part of the soil profile, primarily the A and B horizons.

Soil horizon - A layer of soil, approximately parallel to the land surface and differing from adjacent horizons in physical, chemical and biological properties such as color, structure, texture, consistency, microrganism activity, degree of acidity, etc.

Soil phase - A phase of a soil series based on different features that significantly affect the soil's use and management, such as texture of the surface layer, coarse fragment content, surface stoniness, and slope.

Soil profile - A vertical cross-section of a soil composed of layers, called soil horizons, commonly exposed by excavating an observation hole to at least 5 feet in depth with a backhoe.

Soil slope - The slope of the soil surface has several distinct properties including gradient, complexity, configuration, length, and aspect. In soil science, slope is considered a property of the soil not a landform like a ridge or a valley side.

Soil texture - Soil texture refers to the USDA classification of texture, which is based on proportion by weight of the several soil particle size classes finer than 2 mm in equivalent diameter. The portion of soil mterial finer than 2 nm is called the "fine earth fraction". Materials larger than 2 mm are called rock fragments and each particle size class is called a "soil separate".

Stoniness - See table of surface phase names and stoniriess classes on next page:

Subsoil - The portion of the soil below the plow layer, or surface layer, down to the underlying substratum.

Substratum - The soil material below the A and B horizons of the soil profile, relatively unaffected by weathering processes. It may or may not be like the soil mterial from which the horizons above have formed.

Surface soil - The upper layers (horizons) of the soil profile that are intermixed due to cultivation or other disturbance, often termed topsoil, typically dark in color because of its high organic matter
content.

Surface Phase Classification

Stoniness Class	Phase Name	Surface Covered (%)
0	Nonstony	Less than 0.01
1	Stony or bouldery 1/	0.01-0.1
2	Very stony or Very bouldery 1/	0.1-3.0
3	Extremely stony or Extremely bouldery 1/	3.0-15
4	Rubbly 1/	15-75
5	Rubble land 2/	More than 75

1/ The term "bouldery" is used if boulders dominate stones as a limiting factor, even though stones may occupy a greater proportion of the soil surface.

2/ Areas this stony are treated as the type of miscellaneous area, "rubble land".

APPENDIX F

SUMMARY OF SOIL SURVEY GUIDELINES FOR SITE LOCATION OF DEVELOPMENT PROJECTS

The Maine Association of Professional Soil Scientists has adopted minimum standards for soil surveys. Soil surveys are separated into four classes, depending on the amount of detailed information required for the project. The Maine Department of Environmental Protection has correlated these classes to various types of development for projects requiring their review and approval under the Site Location of Development Law. The minimum standards for the four classes of soil surveys and the types of projects associated with each class are summarized below.

I. <u>Class A - High Intensity Soil Survey</u>

A. Project Descriptions:

1. Specific land area within any development proposed for phosphorus control measures including wet ponds, infiltration facilities, and buffer strips
2. Residential and commercial subdivisions where any lot is less than 2 acres and on-site wastewater disposal is proposed

B. Minimum standards:

1. Mapping units of 1/8 acre or less
2. Mapping scale of 1" = 100', or larger
3. Ground control - baseline and test pits located accurately under direction of land surveyor or professional engineer
4. Base map with 2' contour lines with ground survey, or aerial survey with ground control

II. <u>Class B - High Intensity soil survey</u>

A. Project Descriptions:

1. Residential and commercial subdivisions where any lot is less than 2 acres. This requirement may be waived by trhe DEP's technical staff for the undeveloped portion of any individual lot greater than 5 acres, and for undeveoped areas of clustered subdivdions.
2. The land area of a condominium development that will be disturbed during construction. This includes single or multi-family, attached dwellings.
3. Shopping centers or similar commercial developments where large areas are to be used or disturbed.

B. Minimum Standards:

1. Mapping units of 1 acre or less
2. Mapping scale of 1” = 200’, or larger
3. Ground control - test pits located by means of compass and either chaining, pacing, or taping from a known survey point
4. Base map with 5’ contour lines

III. Class C <u>Medium High Intensity Soil Survey</u>

A. Project Descriptions:

1. Residential and commercial- subdivisions where any lot is greater than 2 acres and on-site wastewater disposal is proposed.
2. Golf courses, ski areas, and other multi-use developments.
3. Any project for which DEP requires a hydrogeologic investigation.

B. Minimum Standards:

1. Mapping units of 3 acres or less.
2. Mapping scale of 1”= 500’ or larger.
3. Ground control - as determined by mapper.
4. Base map - as determined by mapper.

IV. <u>Class D - Medium Intensity Soil Survey</u>

A. Project Descriptions:

All other developments that don't require one of the above three soil survey classes.

B. Minimum Standards:

1. Mapping units larger than 3 acres
2. Mapping scale of 1” = 2000’, or larger
3. Ground control as determined by mapper
4. Base map - as determined by mapper

*This intensity of mapping is similar to the Soil Conservation Service (SCS) soils maps that are found in their published survey manuals.